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ABSTRACT

This study was designed to determine the relationship between the black college student's attitude toward science, science self-concept, and other variables of occupational choice and the selection of an academic major. The combined effect of the variables of occupational choice on the selection of an academic major was also examined. Science and non-science majors (N=410) at Morgan State University, Maryland, participated in the study. The student responses to questionnaires were entered into multiple regression analysis; the instruments were as follows: (1) the Purdue Masters Attitude Scale, Form B; (2) Brookover's Science Self-Concept of Ability Scale, Form B; and (3) a questionnaire especially designed for this project (Salters, 1985). Six variables were identified as being significant and accounted for 42 percent of the variance. These variables included: (1) science self-concept; (2) presence of role model; (3) image of the field; (4) course counseling; (5) attitude toward science; and (6) high school science background. References are also provided. (ML)

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THE RELATIONSHIP BETWEEN ATTITUDE TOWARD SCIENCE, SCIENCE SELF-CONCEPT AND OTHER VARIABLES OF OCCUPATIONAL CHOICE TO THE SCIENCE CAREER CHOICE OF BLACK COLLEGE STUDENTS

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The Relationship Between Attitude Toward Science, Science Self-Concept and Several Variables of Occupational Choice to the Science Career Choice of Black College Students

Abstract

The purpose of this study was to determine the relationship between the Black college student's attitude toward science, science self-concept and other variables of occupational choice and the selection of an academic major. A secondary purpose was to determine the combined effect of the variables of occupational choice on the selection of an academic major.

The sample for the study consisted of 410 science and non-science majors at Morgan State University, Baltimore, Maryland.

The Purdue Masters Attitude Scale, Brookover's science self-concept of ability scale and a questionnaire developed by the principal researcher was used to collect the data, test the hypothesis, and answer the research questions.

The results revealed that selection of major was related to ten of the twelve variables investigated. Multiple regression analysis revealed that only six of the variables could be identified as making a contribution of greater than one percent. These variables were: (1) science self-concept, (2) presence of role model, (3) image of the field, (4) course counseling, (5) attitude toward science and (6) high school science background.

Detailed analysis of the multiple regression results revealed that science self-concept explained 21% of the variance in science as a major. Role model explained another 11% of the variance for a total of 32%. These two plus the four additional met the criterion of a sizeable contribution. Collectively, these six variables accounted for 42% of the variance.

INTRODUCTION

In recent years, the entry rate of black students into college has been acceleating faster than student admission in general. In spite of this influx of Blacks into the Nation's universities and colleges, America's Colleges and Universities have been unsuccessful in channeling representative number of Blacks into science careers. (Rowe 1977).

Unfortunately only a few studies have considered factors that may mitigate against Blacks participating in the sciences. Tilford and Allen (1973) surveyed Black college students at several predominantly Black institutions "to assess the unique experience of the Negro in American Society, and the relationship of this experience to the development of "scientific talent". They concluded: (a) that "pure" science fields attracted more academically able students; (b) that there are no differences in the family background of science and non-science majors; (c) that high school activity and level of integration does not affect choice of college major; (d) that persons from the home and school were influential to varying degrees in the students' choice of their fields; (e) that there was a difference in attitude favoring science majors.

Dillon and James (1977) in a similar study, investigated the relationship between attitudes and behavior of Blacks with respect to the scientific enterprise and perception derived from their unique experience as Black Americans. Their study concluded that the affective consequence of being a Black American, seem to be a pervasive factor in the views of Black college students toward science.

Jacobowitz (1983) investigated the relationship of sex, achievement and science self-concept to the science career preference of Black high school students. Her findings suggest that early adolescent science career preferences are related more to interest consonant with sex-role consideration than realistic assessment of mathematics/science achievement.

Finally, Atwater (1984), investigated cognitive and affective variables affecting Black freshmen in science and engineering at a predominantly White University. A sub-sample of 79 Black college freshmen was surveyed. The results revealed that competence in mathematics was a significant factor related to their achievement and some measure of attitude seemed important.

Concerning Blacks, Rowe (1977) has proposed that career orientation, teacher expectation, course counseling, persistence of students, availability of role models, the image of science, time of exposure to science and involvement in science projects, may affect careers of Blacks in science. Because of the paucity of research in this area, the study represents an attempt to expand the research knowledge in this area.

PURPOSE

The purpose of this study, was to determine the relationship between the Black college student's attitude toward science (ATS), science self-concept (SSC) and several other variables of occupational choice and the selection of science as a major. A secondary purpose was to determine the combined effects of these variables of occupational choice on selection of major.

PROCEDURES

The population for this study was 410 Black undergraduate students at Morgan State University, Baltimore, Maryland. Students were categorized as science or non-science majors.

Students were surveyed via the use of an instrument that consisted of the Purdue Masters Attitude Scale, Form B, (ATS), (Remmers, 1960), Brookover's Science Self-Concept of Ability Scale, Form B (SSC), (Brookover, Paterson, and Thomas, 1965) and a questionnaire developed by the principal researcher (Salters, 1985) designed to provide data about the variables of occupational choice (VOOC) in terms of their relationship to the selection of science as a major.

Basically, the instruments assessed the relationship between the students ATS, SSC, and the VOOC, i.e., Career Orientation, Persistence, Image of Science, Teacher Expectation, Course Counseling, Role Model, Exposure to the Field, Family Influence, Socio-economic Status, High School Activities and the selection of a major. The instrument was also designed to assess the combined effects of these variables on the selection of a major.

Based on the above variables, a null hypothesis having two forms were derived.

Form 1. The mean of science majors is equal to the mean of non-science majors (non-directional).

Form 2. The mean of science majors is less than or equal to, the mean of non-science majors (directional).

RESULTS

TABLE 1

HIGH SCHOOL SCIENCE COURSES COMPLETED BY MAJOR

High School Science Course	MAJOR: Non-Science (N=178)	MAJOR: Science (N=232)	Total (N=410)
General Science	68.5%	66.4%	67.3%
Biology	84.8	87.9	86.6
Earth Science	36.0	37.5	36.8
Chemistry	42.1	74.1	60.2 *
Physics	19.7	40.1	31.2 *
Physical Sciences	26.4	24.6	25.4
TOTAL	100.0	100.0	100.0

* Significant at .05 Level

Data analysis involved: (1) frequency table, (2) cross-tabulation, (3) one-way analysis of variance, (4) factorial analysis, (5) phi-coefficient, (6) point biserial correlation, (7) chi square, and (8) multiple regression.

RESULTS

Table 1 presents the percentages of science majors, non-science majors, and total of all students completing each of six separate high school science courses. For chemistry and physics, the chi square test of equal proportions was rejected. For other courses, it was not rejected. A larger proportion of science majors completed courses in chemistry and physics than non-science majors. The single science course most frequently completed by science and non-science majors was biology followed by general science.

An examination of the number of high school science courses completed by science and non-science majors indicated that the mean number of courses completed was 3.1 with a range from "0" to "6".

Table 2 presents the summary statistics for all variables. The test of significance was based on simple one-way analysis of variance procedures which compared the mean of science majors and non-science majors on ATS, SSC, and various items of occupational choice.

If the content of the item on the questionnaire used to assess the variable did not involve science the non-directional hypothesis (Form 1) was used. On the other hand, if the content made specific references to the field of science, the directional hypothesis (Form2) was used.

The results presented in Table 2 show that Black college students, when categorized into science and non-science majors, differed signifi-

TABLE 2

SUMMARY STATISTICS FOR VARIABLES OF OCCUPATIONAL CHOICE

Variable	Total	Non-Science N	Non-Science Mean	Science N	Science Mean	Point Biserial
ATS Score	410	178	6.80	232	7.74	0.30*
SSC Score	410	178	27.19	232	31.60	0.46*
Career Orientation						
Confident about career opportunities in chosen major	410	178	1.69	232	1.69	0.00
Not familiar with career opportunities in area of science	410	178	2.86	230	3.69	0.38*
Persistence						
Adequate time to prepare	410	178	1.48	232	1.47	-0.01
Time required to become a scientist too long	410	178	2.86	232	3.37	0.23*
Image of Field						
Science is difficult	409	177	2.74	232	3.31	0.25*
Takes too long to become a scientist	407	176	2.95	231	3.40	0.21*
Would not pursue science as a major	406	175	3.27	213	3.96	0.57*
Could obtain a job in science if qualified	407	175	2.45	232	2.90	0.19*
Teacher Expectation						
English	410	178	3.65	232	3.85	0.12
Science	410	178	3.21	232	3.83	0.39*
Mathematics	410	178	3.53	232	3.79	0.15*
Social Studies	410	178	3.66	231	3.83	0.09

* Significant at .05 Level

TABLE 2 CONT'D

SUMMARY STATISTICS FOR VARIABLES OF OCCUPATIONAL CHOICE

Varaible	Total	Non-Science N	Non-Science Mean	Science N	Science Mean	Point Biserial
Course Counseling						
English	408	177	4.23	231	4.24	0.01
Science	408	177	3.69	231	4.38	0.42*
Mathematics	408	177	4.14	231	4.34	0.18*
Social Studies	408	177	3.91	231	3.77	-0.08
Role Model						
Had a role model in chosen field	409	177	0.70	232	0.62	-0.09
Major choice decision influenced by a role model	408	177	0.49	231	0.52	0.02
Science or Non-Science	410	178	0.08	232	0.49	0.45*
Time of Experience to Field						
Age of first interest in chosen field	410	178	16.08	232	15.53	-0.06
Age of first interest in area as a major	410	178	17.46	232	16.96	-0.07
Family Influence						
Mother/stepmother	408	177	3.24	231	3.58	0.11*
Father/stepfather	406	176	2.76	230	3.13	0.12*
Grandparents	396	172	2.15	224	2.41	0.08
Brother/step-brother	391	173	2.30	218	2.65	0.11*
Sister/step-sister	389	173	2.45	216	2.60	0.06
Other	305	140	2.56	165	3.02	0.13*
Family influence Index	408	177	3.82	231	4.11	0.05
Income $25,000	410	178	0.56	232	0.53	-0.03

* Significant at .05 Level

TABLE 3

PERCENTAGE OF HIGH SCHOOL ACTIVITY PARTICIPATION BY MAJOR

High Schcol Sctivity	Total (N=410)	Non-Science (N=178)	Science (N=232)	Phi Coeff.
Officer in senior class.....	28.0%	27.5%	28.4%	0.01
Lettered in athletecs.....	48.5	50.6	47.0	-0.04
Placed in advanced class.....	56.6	48.3	62.9	0.15*
Member of Science Club.....	31.0	14.0	44.0	0.32*
Member of Math Club.....	11.7	13.5	10.3	-0.05
Member of History Club.....	15.6	16.3	15.1	-0.02
Member of English Club.....	15.1	19.1	12.1	0.10*
Took more courses than required...	70.0	65.7	73.3	0.08
Worked on High School Newspaper.....	26.8	33.7	21.6	-0.14
Member of Musical Group.....	42.2	42.1	42.7	0.01
Participated in Drama Productions	32.0	33.7	30.6	-0.03
Member of National Honor Society...	28.5	24.7	31.5	0.07
Participated in Science Fair....	38.0	28.7	45.3	0.17*
Participated in Upward Bound....	17.1	16.9	17.2	0.01
Published Paper.	22.9	26.4	20.3	-0.07
Participated in Debating Club...	20.5	23.6	18.1	-0.07
Other Participation...	15.6	14.6	16.4	0.02

*Significant at .05 Level

TABLE 4

PERCENTAGE INFLUENCED BY HIGH SCHOOL ACTIVITY BY MAJOR

High School Activity	Total (N=410)	Non-Science (N=178)	Science (N=232)	Phi Coeff.
Officer in senior class.....	16.3%	18.0%	15.1%	-0.94
Lettered in athletics.....	22.9	27.0	19.8	-0.08
Placed in advanced class.....	42.4	36.0	47.4	0.12*
Member of Science Club.....	21.7	5.6	34.1	0.34*
Member of Math Club.....	5.4	6.7	4.3	-0.05
Member of History Club.....	11.2	10.1	12.1	0.03
Member of English Club.....	9.3	11.8	7.3	-0.08
Took more courses than required...	47.6	44.9	49.6	0.05
Worked on High School Newspaper.....	13.4	19.1	9.1	-0.15*
Member of Musical Group.....	16.1	20.2	12.9	-0.10
Participated in Drama Production.....	12.7	15.7	10.3	-0.08
Member of National Honor Society...	21.0	15.2	25.4	0.13*
Participated in Science Fair....	23.4	8.4	34.9	0.31*
Participated in Upward Bound....	12.4	11.2	13.4	0.03
Published Paper.	11.7	15.2	9.1	-0.09
Participated in Debating Club...	12.4	15.7	9.9	-0.09
Other Participation...	11.5	10.1	12.5	0.04

*=Significant at .05 Level

cantly for the variables: (1) ATS score; (2) SSC score; (3) career orientation familiarity; (4) persistence; (5) image of the field (science); (6) teacher expectation (English, science, math); (7) course counseling, (science and math); (8) role model (science or math); and (9) family influence (mother/step, father/step, brother/step, and others). Items revealing a significant difference for the above variables were tested using the directional hypothesis, (Form 2).

During the survey students were asked to indicate which of the 17 high school activities they participated in, and the degree to which that activity contributed to their decision to select their present major (see Table 3). Students were also asked to indicate the degree that activity influenced their decision to select their present major. (See Table 4).

For activity participation, Table 3 shows that science and non-science majors differed significantly on the variable, placed in advanced class, member of Science Club, worked on high school newspaper and participated in Science Fair. In terms of activity participation exerting some influence on the selection of science as a major, Table 4 shows that the students differed significantly for the variables placed in advanced class, member of Science Club, worked on high school newspaper, member of National Honor Society, and participated in Science Fair.

Since Tables 3 and 4 show four (4) items significant in both tables, these items were factorially analyzed, as well as all variables assessed with multiple items to reduce scores for the related item collection to a single score. The variables that were factorially analyzed included: (1) Image of the Field, (2) Course Counseling, (3) High School Science Background, (4) Teacher Expectation, (5) Participation in High School

TABLE 5

MULTIPLE REGRESSION SUMMARY

Independent Variable	Multiple R	R Square	RSQ Change	Simple R
Science Self-Concept Score	0.457	0.209	0.209	0.457
Presence of Role Model	0.564	0.319	0.110	0.445
Image of Field	0.608	0.369	0.051	0.432
Course Counseling	0.623	0.388	0.019	0.301
Purdue ATS Score	0.654	0.404	0.016	0.386
High School Science Background	0.646	0.417	0.013	0.308

Activities, and (6) Family Influence. These variables, along with (7) ATS Score, (8) SSC Score, (9) Persistence and (10) Presence of a Scientist Role Model were entered into a multiple regression (MR) equation to determine the linear effect of these independent variables on the dependent variable major.

The Multiple Regression summary is presented in Table 5. It shows that six of the independent variables were identified as making a contribution greater than one percent on the dependent variable major. Further examination of Table 5 shows that science self-concept explained twenty-one percent (21%) of the variance in science as a major. Role Model explained another eleven percent (11%) of the variance for a total of thirty-two percent (32%). These two plus the four additional variables met the criteria of a sizeable contribution. Collectively, these six account for fourty-two percent (42%) of the variance of the dependent variables.

DISCUSSION

Ten independent variables were found to be separately related to the dependent variable major; of these, only six were identified as making a sizeable contribution. These variables were: (1) SSC, (2) presence of role model, (3) image of the field, (4) course counseling, (5) ATS and (6) high school science background.

The finding that science self-concept accounted for the major proportion of the variance is consistent with Super, et al (1957) who ascertained that one attempts to select an occupation that will be compatible with one's self-concept. It is also consistent with Brookover's (1965 and 1967) finding that academic self-concept is a better prediction of academic achievement than global self-concept.

One half of all students surveyed reported that they were influenced by a role model. However, when the students were categorized into science and non-science majors, 49% of the science majors reported that their role model was in the area of science compared to 8% of the non-science major. If the paucity of Blacks in science trend is to be addressed, every effort must be made to expose young Blacks at an early age to role models that could be influential in channeling more Blacks into the physical and biological sciences.

Image of the field accounted for a significant proportion of the variance also. The results showed that students when categorized as science and non-science majors differed significantly. Most non-science majors believed that science was necessary for progress but when the question became one of personal contact, science as a career choice was overwhelmingly rejected.

Efforts must be made to correct the distorted images young Blacks hold toward science. One need not be superlatively good to major in science. (Mead, 1957).

Course counseling accounted for a significant proportion of the variance also. The results of the survey indicate that science majors differed significantly in the degree to which they were encouraged to study in science and mathematics from non-science majors. Rowe (1977) points out that a background which includes four years of high school mathematics increases the chances that a student will survive a rigorous college program. If counselors and teachers are abreast with career opportunities, training requirements and the prospect for promotions in science, they can serve as an important pathway for channeling more Blacks

into the area of Science.

Attitude toward science also accounted for a significant proportion of the variance. As with the SSC score the mean ATS Score of science majors was significantly higher than that of non-science majors. These findings are consistent with Kahle's (1982) analysis of the 1976-77 National Assessment of Educational Progress data which indicated that minority students do have positive attitudes toward science, however, these attitudes have not been accompanied by higher achievement levels. If Blacks are to be equitably represented in the scientific enterprise, then we, as educators must become concerned with those who are not exactly interested or motivated in science. Science educators must also become concerned with the science student who is interested in science but changes his/her mind in college and enters a field other than the physical and biological sciences.

High school science background too, accounted for a significant proportion of the variance. This finding is consistent with Cooley's (1963) finding in which he found high school courses to be related to choice of a science career. According to the results of the present study, the survey indicated that the course most frequently taken by all students was biology, followed by general science. These findings are not surprising since most states require only a single unit in science for graduation and that this requirement can be fulfilled with a single course in biology or general science depending upon the science curriculum of the school system. In a study conducted by Conant in 1974, he found that elementary school children in portland, Oregon received on an average, not more than one or two minutes of science a day. Nationwide, it ap-

pears that many students never study science formally until the sixth, seventh, or eighth grades, at which time they are abruptly confronted with new vocabulary, abstract reading materials, and laboratory activities requiring quatitative skills which they lack or feel uneasy with. If Blacks are to obtain parity with the majority in the area of science, then efforts must be made to insure that they are exposed to science at an early age and that this exposure continues throughout the student's entire academic career.

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